NASA advances water recycling for space travel, Earth use

Would Columbus have reached the New World if his ships could not carry enough water for their crews? Would Lewis and Clark have made it to the Pacific if they had no fresh water along the way?

The answer is probably no, because water is just as precious to explorers as it is to everyone on Earth. Water is one of the most crucial provisions astronauts need to live and work in space, whether orbiting Earth, working at a lunar base or traveling to Mars. That's why NASA is following several different but complementary avenues at four agency centers to develop dependable ways of recycling water.

"Developing innovative life support technologies will reduce risks associated with human space exploration," said Eugene Trinh, director of the Human System Research and Technology Program at NASA Headquarters. "We are working to improve technology used onboard the International Space Station (ISS) and have several research projects under way for future missions to the moon and Mars."

ISS crewmembers must save as much water as possible. Each is allocated about two liters daily. They stretch the ration by collecting, cleaning and reusing wastewater, condensate in the air and urine. A new technology to improve recycling on the ISS is being developed by engineers at Hamilton Sundstrand Space Systems International, Inc., Windsor Locks, Conn., and researchers at NASA's Marshall Space Flight Center (MSFC), Huntsville, Ala. The Water Processor Assembly (WPA) will be the first major hardware delivery of the Regenerative Environmental Control Life Support System. The WPA and the Urine Processor Assembly make up the Water Recovery System (WRS), which feeds the oxygen generation system. These combined systems will support up to a seven-member crew.

"The water processing assembly can daily produce 35 gallons of potable recycled water," said Bob Bagdigian, MSFC Regenerative Environmental Control and Life Support System Project Manager. After the new systems are installed, annual delivered water to the ISS should decrease by approximately 15,960 pounds, about 1,600 gallons. The WPA is scheduled for delivery in 2008.

Water purity is also important. Chemical and microbial contaminants make it unappetizing or unhealthy, and it can clog complicated fluid systems. The Aerobic Rotational Membrane System (ARMS) research project at NASA's Kennedy Space Center (KSC), Fla., may help.

"We're trying to move toward a biological treatment method using bacteria to help cleanse the water," said Tony Rector, Dynamac Corporation bioprocess engineer at KSC. The KSC prototype shop fabricated a model of the system. It is being tested inside KSC's Space Life Sciences Laboratory, and Rector and colleagues designed it.

At Ames, a water recycler enabling reuse for three years without resupply is being developed on a timeline to fit into exploration plans, according to Ames scientist Michael Flynn. A preliminary engineering development unit can hourly recycle 13.2 pounds, about one gallon, of waste into drinkable water.

"If we were going to Mars tomorrow, this is the water treatment system astronauts might well use," Flynn said. He is developing it in cooperation with Water Reuse Technology, Inc., Garden Valley, Calif. "This unit can enable a six-person crew to shower, wash clothes and dishes, drink water and flush toilets over three years without resupply," Flynn said.

Engineers at NASA's Johnson Space Center (JSC), Houston, are developing technology to help astronauts live in space. They are studying biological water processors to minimize their size in space habitats. JSC microbiologist Leticia Vega describes her work as making biological water processors modular, so they can be easily removed and cleaned. Researchers are also identifying soaps that rapidly degrade at high concentrations. Cleansers, like shampoo and soap, affect the size of systems, because of the

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time it takes for them to break down. Researchers are studying ways of optimizing size of ion exchange beds used for the final purification of water.

Water recycling technologies developed by NASA will undergo combined water recovery systems testing at JSC to meet exploration timelines. Many of these recycling technologies may have Earth-based uses. NASA is working with the Expeditionary Unit Water Purification Program of the U.S. Office of Naval Research and Bureau of Reclamation to explore ways to use recycling in remote locations.

For information about the Environmental Control and Life Support System, visit: http://www1.msfc.nasa.gov/NEWSROOM/background/facts/eclss.pdf

For ARMS images, visit: http://mediaarchive.ksc.nasa.gov/index.cfm To obtain NASA Ames water recycler publication-size images, please visit http://amesnews.arc.nasa.gov/releases/2004/vpcar/vpcar.html To get more information about the JSC water recovery systems, please see: http://advlifesupport.jsc.nasa.gov/water/index.html

BY JOHN BLUCK